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**LIFE CYCLE COSTING IN INDUSTRY**

**Task 67-21**

**September 1967**

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## PREFACE

To supplement information received from the Department of Defense Life Cycle Costing Test Program, the DoD steering group asked LMI to review the Life Cycle Cost efforts of a number of non-defense companies in order to learn to what extent they use the Life Cycle Cost concept in making procurement decisions.

The assistance rendered by the surveyed companies is greatly appreciated. They devoted considerable time, candidly discussed a relatively sensitive subject, and often provided illustrative proprietary examples. Several companies also supplied special information (e.g., forms and outlines of procedure) which might enable the Department of Defense to better understand industry's methods.

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## I. BACKGROUND

During the last several years, the Department of Defense has been concerned increasingly about the economic implications of awarding procurement contracts on the basis of acquisition price only. Although the Armed Services Procurement Act of 1947 allows a much broader approach by stating, "Award shall be made . . . to the responsible bidder whose bid . . . will be most advantageous to the Government, price and other factors considered," contracting officers almost universally have relied solely upon price except in research and development contracting and in a few major systems procurements.

In late 1963 the Assistant Secretary of Defense (Installations and Logistics) charged LMI with developing basic approaches and techniques for using Life Cycle Costing in defense procurements. Upon completion of this task, LMI submitted a report, "Life Cycle Costing in Equipment Procurement," in April 1965. The 1965 report focused upon the operating and support costs of equipment, defined the specific categories of cost and indicated the possible magnitude of such costs. It was reported that such operating and support costs often were a substantial part of the total cost of a piece of equipment over its expected life. The report observed that these operating and support (or logistics) costs--as well as the purchase price--can vary significantly among suppliers. It concluded that techniques could be devised to allow the Government to predict and measure these logistics costs with tolerances that would allow their use in evaluating bids of potential suppliers. It also presented an approach for including logistics costs in competitive

contract award criteria. The report included a procedure for establishing whether a given procurement should consider the life cycle costs. The procedure acts as a screening process. It establishes not only whether logistics costs should be among the contract award criteria but also which logistics costs should be included. In addition, the report suggested that a test program be devised to permit the Government to explore the utility and economic feasibility of Life Cycle Cost techniques.

Based upon the 1965 report recommendations, the Assistant Secretary of Defense (Installations and Logistics) issued a memorandum establishing a steering group to assure a coordinated DoD approach to LCC. Each Military Department and DSA established a steering group or task group to select, plan and monitor procurements testing the Life Cycle Costing approach. The Services, over the past two years, have used Life Cycle Cost techniques on a number of procurements, and recently the Navy has extended the use of Life Cycle Costing to the evaluation of major ship systems.

Defense industry also has expressed much interest and provided support. Several industry associations have held seminars on the subject, and companies have assisted the steering group through an interchange of ideas.

LMI has served as a technical advisor to DoD during the past two years of testing the Life Cycle Cost concept. In February 1967, it published a "Life Cycle Costing in Equipment Procurement - Supplemental Report" which primarily outlined the progress to date on test cases and answered questions that were often asked during the introductory phase of Life Cycle Costing. LMI was asked to continue its close association with the steering group and to perform some additional assignments related to

Life Cycle Costing. (See the Appendix.) One of these tasks is a look at non-defense industry to ascertain its use of the Life Cycle Cost concept in relation to DoD's use of Life Cycle Costing.

LMI selected nine major industrial companies to visit. These corporations were involved in the following fields: wood products, oil, chemicals, paper, vehicle manufacturing, household consumer products, instruments, and air transportation. Only one of those companies does a significant portion of its business with the Government. The general criteria for selection of the companies were: (1) that the company be a major industrial concern, and (2) that the company operate in an environment which would be conducive to the use of the Life Cycle Costing concept. All the companies were from the 500 largest United States corporations. Seven of them were from among the 125 largest.

DoD Life Cycle Costing is primarily used in selection of equipment with significant logistics cost implications. Therefore, for comparison, interviews with companies concentrated upon how industry selects its capital equipment, rather than upon how it purchases its raw material.

The following pages report the findings that were obtained during visits to the selected companies.

## II. STUDY FINDINGS

### A. Life Cycle Costing Concept

The major finding of this study is that all companies visited use the Life Cycle Costing concept in company operations. The concept was applied to the equipment acquisition analysis process, to the related lease vs. buy decisions, in evaluating bids of potential suppliers, and, by some companies, in pricing the cost of warranties on its own products. Although the design engineering groups in these corporations also used the LCC concepts, those groups were not studied. Such LCC practice in engineering is normal also in Government.

Personnel interviewed indicated that formal procedures for estimating operating and support costs have been used within their companies for many years. From talks with the selected companies regarding what they and their competition are doing with respect to Life Cycle Costing, it appears that the Life Cycle Costing concept is widely used in industry and is considered a common sense approach, and, in fact, is the normal way that industry performs its business analyses.

### B. Life Cycle Costing Methodology

Although industry uses the same concept of Life Cycle Costing as does the DoD, its methods and techniques of implementing the concept vary significantly from those used by the DoD. In industry, after an idea for a project is generated, it is studied at the operating level. Equipment selection for the proposed project generally is made on the basis of an informal



Life Cycle Cost analysis by industrial engineers or part of the operating staff. This choice of equipment is then used to make the detailed profitability forecast for the whole project. The subsequent analysis is then submitted to higher management for approval of the project. When the project is approved, the proposed equipment purchase is also approved. The Government procedure differs in that approval of the need for the project and selection of the equipment are separately submitted for management approval. Specific equipment selection is made after the approval of the requirement.

Industry also differs from the Government in that it does not have to document and justify its action for public scrutiny. In addition, cost elements are not the same in the Government and industry calculations, nor do they have the same degree of importance. Industry includes revenue, raw material costs, and taxes in its analyses, causing operating and supporting costs to have less impact on the resultant decisions. Even with these differences, several features of industry methodology are particularly important and can be useful to Government.

#### 1. Cost Estimating

Industry estimates all relevant costs in an LCC analysis. The amount of accuracy of an industry estimate depends upon its ultimate significance in the total analysis. For instance, on high cost categories much more effort and detail are put into deriving an estimate than is done for low cost factors. Industry as a whole considers costs of: corrective and preventive maintenance; training; inspection, installation, and checkout; transportation; manpower; and other operating costs such as fuel and utilities. The only major category

analyzed by the Government, but not by all companies visited, was inventory management costs. This is not considered a significant cost by several of the companies visited. However, in other companies, such as an airline interviewed, inventory management of spare parts is a very significant cost.

Companies also include costs not relevant to Government operations, such as taxes and costs of marketing the product. Some of the companies visited use the cost of equipment downtime as a factor. Companies often make arbitrary estimates of significant cost elements if data for accurate estimating are not available.

## 2. Estimates of Useful Life

Industry Life Cycle Cost estimates are projected for each year of the entire useful life of the equipment rather than over the first few years of operation as has been the tendency in DoD Life Cycle Cost test procurements. Industry indicated that an analysis of the total life of an equipment will often reveal unexpected costs that may not be evident in the early years of operation. One company indicated that by an analysis of the total life of an equipment it had discovered a pattern of maintenance costs on a new supplier's equipment that was not characteristic of its previously purchased equipment. This cost pattern affected the ultimate purchase decision.

## 3. Estimates of Value

Industry differs from Government in estimating value received. DoD looks at effectiveness in a subjective way, while companies consider the potential value of a piece of equipment in the form of dollars of revenue. This revenue calculation can have a major impact upon the apparent profitability of a

project. Many times industry performs a much more detailed analysis of potential revenue than of costs that will be incurred.

In making a purchase decision, some companies consider the differential in revenue that may be generated through reciprocity--reciprocity being agreement by two companies that they will purchase each other's products. An example of this would be an auto transport company that purchases its trucks from the same company for which it hauls automobiles in order to be assured of the auto business.

4. Detail of Maintenance and Support  
Cost Estimates

Industry does not use the advanced techniques of estimating maintenance and support costs that are used by the Department of Defense. Interviewed companies gave several reasons for this. First, those cost factors are not nearly as significant to industry as projected revenue and the costs of raw materials and direct labor. Therefore, industry exerts more effort to make these latter estimates. Secondly, industry personnel have found that historical support data can be used to predict the future with satisfactory accuracy. All of the companies visited used historical data as a basis to estimate costs. Companies usually had a data collection system that periodically collected current operating cost information. Most of the companies' new equipments were similar to equipment they had bought before. Whenever a change in environment or technical process precluded direct use of historical data, it was modified by experienced judgment. Companies believed there was no need for them to use advanced maintainability and reliability calculations.

## 5. Methods of Analysis

Most of the companies visited were concerned with the method(s) used to analyze the cost estimates and translate them into a summary picture prior to submission to top management for approval. As contrasted with industry, up to now the Department of Defense merely has added up the individual cost estimates to arrive at a summary figure. Industry uses several techniques for analysis; e.g., payback, average annual rate of return, discounted cash flow rate of return, and present value. Industry financial personnel point to the different answers that can be obtained from these methods and the shortcomings of each method. Often a company will use more than one method in a presentation to top management. Most companies believed that discounting costs and revenue to reflect the time value of money was an integral part of the analysis. Although not all companies presently use a discounted cash flow calculation, the financial people in those companies indicated that the discounting concept was under review by their top management.

The method of analysis is closely tied in with the method of presenting alternatives to management. All the companies had formalized formats and procedures through which alternatives and their justifications were submitted. Most of the surveyed companies based the decision approval level upon the size of the expenditure. Projects of a certain minimum cost could be approved by a division manager. As the cost of a project or proposed purchase increased, successive levels of approval included the executive vice-president, president, and board of directors. For high cost projects, there is more detailed effort to develop an analysis and justification.

Industry is developing additional techniques of analysis. One company is introducing a computer simulation process to obtain a range of possible outcomes instead of a single point estimate. This process would provide management with a whole spectrum of possibilities and the probabilities of their occurrence.

6. Establishment of Source Selection Criteria

Industry establishes its source selection criteria after receipt of its proposals. This practice varies significantly from that of the DoD and gives the company a much better opportunity to determine what the relevant criteria are. Commercial companies do not need to list every criterion in their solicitations, but can rely upon the suppliers to perform some analyses. The companies can then study the proposals to see what the potential suppliers thought important and modify their criteria as considered necessary.

7. Practices that Facilitate Life Cycle Costing

Industry uses additional techniques which assist in the implementation of the Life Cycle Cost concept. One of these methods is the use of a limited bidders' list. This list usually is comprised of bidders who have previously demonstrated ability to perform in a suitable manner by providing good service and a quality product with reasonable operating and support costs. In this way a company can reduce its cost of qualifying suppliers, be reasonably assured of a good product, and still have competition to keep prices in line. When more competition is desired, the company can invite additional suppliers to bid.

A second method of facilitating Life Cycle Costing is by the use of a warranty. Warranties as used by industry

are closely related to the Department of Defense's procedure of establishing performance specifications and writing in a penalty clause in the contract to assure adequate performance. Some airlines are in the process of developing warranty provisions that they want from the suppliers of their purchased aircraft components. There are three types of warranty that are considered by the airlines, all of which may be included in a single contract. These are: the normal guarantee covering defects in material or workmanship; the guarantee not to exceed a specific failure rate (in the form of a minimum mean time between failures); and the operating cost guarantee which assures the airline of a maximum cost per operating hour. Industry considers warranties one method to assure the validity of suppliers' estimates.

#### 8. Controls on Cost Estimates

The survey indicated that corporations hold contractors and internal estimators accountable for cost and performance claims. To assure accurate estimates, many companies reduce a manager's budget by the amount of projected savings stated in the justification for the purchase of new equipment. The supplier is also held to cost and performance estimates by warranty and by business pressure. In drastic cases the supplier is removed from a bidder's list if he fails to perform in an adequate manner.

## CONCLUSIONS

1. The widespread use of Life Cycle Costing in non-defense industry and the enthusiasm exhibited toward it by company officials give strong support to the value and the validity of the Life Cycle Cost concept. Industry's ability to overcome problems associated with Life Cycle Costing provides assurance to the DoD as to the usefulness of the concept.
2. The environment for LCC in industry varies so substantially from that in the DoD that most practices used in industry are not applicable to the Government environment. Determination of source selection criteria after receipt of bids is an example. However, some of industry's LCC practice does have application to the Government--particularly the inclusion of all cost elements in the analyses and the development of cost estimates over the entire expected life of the equipment. In the course of the test program, the Government already has made substantial progress in considering a large number of costs over a longer portion of the life cycle on individual procurements.
3. Industry has placed much more emphasis on the methods of analyzing cost estimates than has the DoD. While industry has developed discounted return on investment methods, DoD test procurements have merely added up the costs and awarded on the basis of lowest total cost. The Government could learn from industry experience in this particular area even though the objectives of profit maximization and cost minimization are different. The methods of analyses could be investigated more thoroughly by the steering group in coordination with the

Office of the Assistant Secretary of Defense (Comptroller), particularly to develop methods of economic analysis for proposed investment projects justified primarily on the basis of military necessity or combat effectiveness.



ASSISTANT SECRETARY OF DEFENSE  
Washington, D. C.

Installations and Logistics

DATE: 24 May 1967

TASK ORDER SD-271-74  
(Task 67-21)

1. Pursuant to Articles I and III of the Department of Defense Contract No. SD-271 with the Logistics Management Institute, the Institute is requested to undertake the following task:

A. TITLE: Application of Life Cycle Costing  
in Procurement

B. SCOPE OF WORK: The purpose of this task is to advise the Department of Defense in the application of life cycle costing in procurement. The task will involve:

(1) A study of the cost of introduction and management of secondary items of supply in a military supply system. In performing this study, LMI will:

(a) Review and analyze the many studies of supply management costs made by Department of Defense components, outside logistic study groups, representatives of industry, and others. The following efforts will be covered: The Logistics Functional Review being conducted under the DoD Resources Management System (DoD Directive 7000.1); the Depot Maintenance Cost and Production Reports (DoD Instructions 7220.14 and 7720.9); and the DoD Warehousing Gross Performance Measuring System (DoD Manual 5105.34-M).

(b) Review and analyze the reports and recommendations made to the DoD Life Cycle Costing Steering Group by the Army, Navy, Air Force, and DSA working groups on Supply Management. (Reports are due 1 October 1967.)

(c) On the basis of the above analyses and any required additional study, develop and propose standard procedures for use by military department and DSA personnel in establishing costs of introducing and managing items in the military supply system.

(2) Utilizing data provided by DoD personnel and employing the procedures developed above, establish and identify the cost factors which represent average or approximate costs for the introduction and annual materiel management of a secondary item of supply within the DoD.

(3) Review of the techniques used by industry for commercial (non-Government) life cycle costing type procurement decisions. This review will involve selection of a sample of companies and an investigation of the practices of those companies in forecasting operation and support costs for the purpose of making procurement decisions.

(4) Maintenance of a continuous working relationship with the Life Cycle Costing Steering Group in the interest of rendering advice, as necessary, in the present test program on this concept.

2. SCHEDULE: B(1) will be completed with the submission of a report by 31 January 1968. B(2) will be completed with the submission of the applicable cost factors by 30 June 1968. B(3) will result in a series of memorandum reports to the Co-chairmen of the Life Cycle Costing Steering Group and will be completed by 31 March 1968. B(4) will continue through 30 June 1968.

/s/ Paul R. Ignatius

ACCEPTED /s/ Barry J. Shillito

DATE May 24, 1967